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ABSTRACT

This paper describes efforts made by the faculty at Santa Fe Community College (Florida) to provide a learning-centered instructional environment for students in an introductory statistics class. Innovation in instruction has been stressed as institutions switch from "teacher-centered classrooms" to "student-centered classrooms." The incorporation of technology into content delivery reflects goals set forth by organizations like the American Mathematical Association of Two-Year Colleges. The paper describes one faculty member's class which combines content, technology and active learning. In the class, students are able to communicate with the instructor, attend virtual office hours, and participate in group discussions through e-mail. In addition to minimal traditional lecturing, instructors incorporate multiple pathways through learning materials to appeal to students with diverse learning styles. PowerPoint presentations, Lyris list server, a course Web site, and prepared lecture notes through a course supplement called the STAT PACK, are among the avenues employed. In addition, students are encouraged to improve their writing skills by providing articles for the STAT TALK newsletter. Although students were dichotomized according to previous computer skills background, the class still had a higher percentage of completers earning a passing grade than that seen for the overall statistics department. Development and improvement of such learning-centered instructional environments will continue. (JCC)

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PROVIDING A LEARNING-CENTERED INSTRUCTIONAL ENVIRONMENT

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U.S. DEPARTMENT OF EDUCATION
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Providing a Learning-Centered Instructional Environment

Abstract

This paper provides a basic description of STA 2023, Introductory Statistics, as taught by Dr. Ruby Evans, Professor of Mathematics and Statistics, at Santa Fe Community College (SFCC), Gainesville, Florida. Students who enroll in sections of the course taught by the author are exposed to multiple pathways through learning materials in a web-enhanced, traditional classroom setting. Technologies utilized in the class include Adobe Acrobat Reader, E-mail, Lyris list server, a web browser, and a class web page, the World Wide Web (WWW), Power Point presentation software, Microsoft Word, MINITAB statistical software, and TI-83 graphing calculators and Graph Link software. The author also incorporates a self-authored lecture supplement, The STAT PACK, which consists of prepared lecture notes. The course provides a learning-centered instructional environment and blends content, technology, and active learning.

Introduction

Annas (1992) defines a radical teacher as one who provides a student-centered classroom, rather than a teacher-centered classroom. Teacher-centered classrooms generally follow the standard "instructor lectures, and students take notes" format. There is limited instructor-student discussion and students are relegated to a passive role, with the instructor acting as the sole agent of information distribution. To facilitate a learning-centered instructional environment, a radical professor must openly avoid the teacher-centered course format and opt for a student-centered, active learning environment. In a learning-centered classroom, the radical professor lectures less and actively engages students in the teaching and learning process. The general goal is to foster advanced cognitive development in students. Often, multiple pathways through learning materials are available. The best new classroom practices involve students through hands-on experiences, use their knowledge, and confirm their skills (McNeal, 1998, p. 90).

Teaching statistics at the secondary and post-secondary levels has undergone serious reform in the last decade, primarily as a result of the push to integrate technology into course delivery (Starkings, 1996). Little has changed with respect to the need for students to actively engage in the process of learning a new language, as statistics is subject matter replete with technical terms. Now, as in the past, students continue to need encouragement to learn the language of statistics, its terminology, its associated symbolism, and its practical applications.

College Background and Technological Environment

Santa Fe Community College (SFCC) is one of Florida's 28 public community colleges, with a full-time student population in excess of 12,000 and an average class size of 24 students. The Department of Mathematics and Statistics at the college supports the integration of computer technology in all instructional delivery of all mathematics courses via two computer labs.

Since the fall semester of 1995, students at the college who have enrolled in STA 2023 have been required to meet once weekly, in a round-robin format, in one of these two department computer labs. STA 2023 is the second largest course of enrollment in the mathematics curriculum. Students may use the computers to check e-mail, surf the Internet, access a class web site, access Microsoft Word for word processing, access PowerPoint presentation software, import graphic images from TI-83 calculators, and run the statistical software package MINITAB for data analysis. Student access to the Math Department computer labs is limited to class time for which the student is registered for coursework.

Initially, the department computer labs were equipped with 16 computers, 15 of which were available for student use in pairs. One was reserved as the lead computer for instructor modeling and on-screen projection of concepts. Due to rapid changes in technological hardware and software, these computer labs were upgraded in the summer of 1999 to state-of-the-art computers, operating in the Windows NT environment, and equipped with CD-ROM drives, floppy and ZIP drives and large-screen color monitors.

Incorporation of technology into content delivery represents a college-wide and departmental goal of implementing standards regarding greater use of technology in the Mathematics curriculum as espoused by the American Mathematical Association of Two Year Colleges (AMATYC) and the National Council of Teachers of Mathematics (NCTM). Approximately 25 sections of STA 2023 are offered in a fall or spring semester, enrolling more than 750 students in what are intended as technologically enhanced courses in statistics; in six-week summer sessions, 7 or 8 sections of STA 2023 are offered, enrolling well over 200 students. Annual course enrollment generally exceeds 2,000 for a typical calendar year; this enrollment covers the main campus of Santa Fe Community College, as well as its downtown campus, satellite campuses, and online course offerings.

As a college-wide initiative, Santa Fe Community College (SFCC) offers registered students whose enrollment has been verified access to state-of-the-art computer technology in the form of hardware and software. Students can utilize the capabilities of the Technology Lab, a.k.a. the Big Open Lab (BOL) housed on the second floor of Building N, the Technology Building. Students frequent the BOL to complete the required technology/computer assignments associated with various courses. A minimum of 3-5 hours weekly outside of regular class time is a fair estimate of computer access time required for STA 2023. Students having personal computer access off campus, at

home, or via the University of Florida typically elect to visit the Big Open Lab less frequently.

The Department of Mathematics and Statistics receives instructional support via an auxiliary Math lab. Students taking courses offered via the Department of Mathematics and Statistics may receive tutorial assistance in content material through the Math Lab. Students are encouraged to visit the Math Lab during official hours of operation to receive help in mastering the mechanics of problem-solving in Statistics. Assistance is generally provided on a first-come/first-serve basis. Historically, wait time prior to receiving assistance has been positively correlated with the number of students requesting assistance.

Course Format

The author integrates technology in all sections of STA 2023. Students are advised from the first class meeting that the course is technology-enhanced via instructional integration and instructional modeling and that they are expected to use current technologies, the TI-83 graphing calculator, and the statistical software package MINITAB. Emphasis is placed on applied statistics in the form of statistical inference and layman's interpretation; algebraic tedium and computation are de-emphasized in favor of applying statistics to real-world problems, data analysis, and subsequent interpretation. Students use computers to perform statistical data analyses, generate word processed documents, develop PowerPoint presentations, send and receive e-mail, visit the class web site, browse the Internet, and participate in the class group discussion list.

MINITAB, the statistical analysis program, is the software of choice for all sections of STA 2023. Throughout the semester, students are required to use MINITAB, the TI-83 graphing calculator, and Microsoft Word (or an equivalent word processing program) to produce statistical output, statistical reports and resulting interpretations.

Student Backgrounds

Students entering the introductory statistics course can originate from any discipline or intended program of study; however, historical data show that over 96% of students who enroll indicate the Associate of Arts transfer degree as the intended objective. To date, the only prerequisite for STA 2023 is MAT 1033: Intermediate Algebra. Consequently, students who elect to enroll in this class have varying backgrounds with respect to computer skills and technological proficiency. A first-day survey is given, which asks students to rate themselves with respect to familiarity with basic computer applications and overall technological proficiency. The lack of demonstrated competence in basic computer skills, prior to course enrollment, has proven problematic for many students, as well as for instructors charged to actively incorporate technology into instructional delivery. Depending on instructor depth in the use of computers, students may find themselves naturally dichotomized into one of two cohorts.

Cohort 1 consists of those students with a fundamental grasp of computers, spreadsheets, E-mail, electronic mailing lists, web sites, browsers, and Internet use. This group has relatively little difficulty getting "up and running" with the technologically enhanced course in introductory statistics. Learning the statistical package - MINITAB - integrated into course delivery has historically existed as an insignificant problem for students in the computer literate cohort. Based on empirical data as collected in end-of-term evaluations, the computer literate cohort feels as if the class represents a valuable "two-fer", two for the price of one: content instruction in statistics, plus the opportunity to acquire and readily utilize established or new computer skills.

Cohort 2, in contrast, consists of students who suffer from computer phobia or who have simply never routinely used a computer. These students, whose computer skills are weak, barely existent, or even nonexistent, struggle in the class. A small percentage of students, who by self-identification are dichotomized into Cohort 2, cannot overcome computer phobia and drop the technologically enhanced course as described by the author. Invariably, multiple problems and frustrations may arise for these students who are trying to learn content material as well as technological applications; many report feeling as if they are being shortchanged. Given past classroom environments and conditioning, these students bemoan that not enough content is covered in the traditional sense. They cite too much required use of computers as a dominant reason for course withdrawal. While incorporation of computers and related applications frees up time for in-depth coverage of content material and statistical applications, this second cohort historically reports difficulty grasping the content material, primarily due to the lack of technological readiness.

In sections of the course that the author teaches, students receive a help packet of basic MINITAB commands on the first day of classes. This help packet is basically a quick summary on "how to" generate desired statistical output using MINITAB. Students have self-reported using the packet religiously throughout the course. To minimize individual student frustration across cohort 2, students are also required to engage in cooperative and collaborative learning (end-of-term research projects). The purpose is two-fold: students practice working together for a common goal--a great project. The project score also counts as a portion of the students' overall grade. Individual grades may differ across the project as scores are based on three criteria: professor, self, and peer ratings.

Generally, a natural pairing of students who are computer literate and those who are not evolves for the collaborative projects. This pairing has historically occurred, devoid of any specialized assignment or identification of student personality types. Moreover, the research projects have worked well to facilitate greater understanding among students, increase opportunity for active learning, and provide extended avenues for peer interaction. Those students having a better grasp of statistical content self-report even greater understanding when explaining concepts and procedures to their peers.

Strategies for Providing a Learning-Centered Instructional Environment

On the first day of class, students are asked to provide the professor with a valid E-mail address, either off-campus or on. Currently, figures range from 50-75% of students who provide off-campus E-mail addresses and report having access to personal computers. The remaining percentage use the E-mail account provided by the college. The author initiates a class mailing list for all sections of the course; in a fall or spring term, list members for the author's classes, range from 100 to 120; summer terms, 60-90. Students submit selected assignments and personal messages to the professor through individual E-mail accounts. The class mailing list distributes information and updates to students regarding deadlines, announcements, and assignments. Students also utilize the mailing list to ask questions of each other, regarding content material and technological applications.

The author incorporates multiple pathways through learning materials to accommodate differences in student learning styles and provides continual opportunities for help as needed through office hours in real time, as well as through virtual office hours. Minimal chalk and talk lectures, PowerPoint presentations, multiple in-class handouts (also available for download via the class web site), Prepared Lecture Notes, and a course supplement known as the STAT PACK are all pieces of the puzzle that fit together to provide a learning-centered instructional environment. Technological applications include MINITAB, TI-83 graphing calculators, PowerPoint, E-mail, Lyris list server, and the course web site.

Students are afforded the opportunity to hone their writing and speaking skills through periodic writing assignments known as concept summaries. The concept summary, a technique that may be used to encourage students to write across the curriculum, is a written assignment that requires the student engage in thought and reflection about a concept covered in traditional classroom instruction. A concept summary should require a review of key concepts, a writing component, and, ideally, integration of a basic word processor.

In-class review activities, in-class computer lab assignments, a summary portfolio, a research project, and an associated PowerPoint presentation to the class are other strategies for facilitating a merger between content, technology, and active learning. Students practice organization skills through production of portfolios and group research projects. Along with the research projects, in-class review and computer lab activities reinforce collaborative and cooperative learning skills.

STAT TALK Newsletter - Writing across the Curriculum

Additionally, students write articles for an electronic newsletter, STAT TALK. The number of articles submitted for publication consideration varies from semester to semester; this number appears to be positively correlated with the class frequency of usage of e-mail and the list serve. In the 1998 fall file copy, students were zealots with respect to electronic communication. E-mail, list serve, and newsletter submissions were at an all time high, and the use of the campus mailing list serve revealed courses taught by the author as having the highest frequency of usage. In STAT TALK, students have

the option of submitting articles to the author for editorial review. These articles, if posted online, may be presented with or without a byline; hence some articles list the author as anonymous. Students are free to write about anything they choose with respect to the class, barring offensive language and commentary.

Articles contained in the online newsletter may be categorized as content related, inspirational and advisory. Content articles focus on a particular topic in statistics as covered by the author in the class. Inspirational pieces may be directed at either students or the professor. The articles offering advice typically discuss "how to study" and "how to survive" Flight STA 2023. On average, the technologically enhanced learning centered environment tends to generate 30-50 articles per semester from enrolled students; approximately 80-90% of these articles are worthy of publication post-editorial review. All articles are edited for grammar, syntax, and punctuation; articles based on subject matter and core content were also edited for accuracy by the course professor.

Invariably, articles submitted for publication are positive and upbeat, thus giving rise to two schools of thought, regarding those students who submitted articles: (1) students were afraid to post anything negative and by default students only submitted positive commentary or (2) students really enjoyed the course, and this form of participation and their writings reflected the same. There may be other perspectives as well, but these two readily come to mind.

The teaching metaphor (Grasha, 1996) represents a teaching analogy originally implemented by the professor in early 1990. In this analogy, the passengers (the students) embark on a flight (the course, STA 2023) with a pilot/captain (the professor). It is both interesting and enjoyable to note that many students display exceptional creativity in incorporating the flight analogy into their writings.

Conclusion

Recent statistics (20 December 1999) regarding sections of STA 2023 taught by this author include the following:

Findings Spring 1999

114 registered in a traditional section of STA 2023

93 (81.6%) were completers

21 (18.4%) withdrew from the course (dept. wide withdrawal rate=16%)

Completers were not necessarily successful
Successful =earned an A, B+, B, C+, or C grade

Only 71 (76%) of the completers earned passing grades (Statistic for dept. = 70.5% earned passing grades)

Findings Fall 1999

118 (15.9% of department total) registered in a traditional section of STA 2023

95 (80.5%) were completers
23 (19.5%) withdrew from the course (dept. wide withdrawal rate=14.5%)

Completers were not necessarily successful
Successful =earned an A, B+, B, C+, or C grade

Only 79 (83.2%) of the completers earned passing grades (Statistic for dept. = 70% earned passing grades)

While the workload is heavy for students and professor alike, statistics show those students who attend class regularly, listen to flight instructions, and then subsequently follow those flight instructions tend to make good grades and demonstrate basic statistical competence, as well as technological proficiency in multiple applications. Inevitably, as the technological revolution continues to unfold, it appears that a required course in "basic computer literacy" must be incorporated into general education requirements. For many classes, especially statistics, this requirement will be a first-semester course. The author envisions it as a prerequisite, not a co-requisite, for most major coursework. In all likelihood, implementation of such a course will not occur until a greater number of faculty is actively incorporating technology in traditional classroom instruction. The author of this paper believes a required computer course will occur -- either by design (institution mandate) or natural progression of events (student recognition that computer literacy is a must and subsequent demand). Courses such as the one described in this

article are ideal forums for actively incorporating technology into traditional classroom instruction to facilitate a learning centered instructional environment.

In support of the learning-centered instructional environment provided in STA 2023, a former student writes the following:

> In my humble opinion, I feel that the electronic version of this class has been quite helpful... The work gets done in a group effort, which fosters a sense of camaraderie that is not unlike the "real world" which we are training for. The idea of an hour-long lecture is not appealing. This is interesting. This is innovative. This is fun. The workload is demanding; it is also good training for the above-mentioned real world. I am grateful for the opportunity to converse with students from other sections of your class, via list serve or e-mail. It is a network that would be impossible to duplicate via phone tree, study groups, etc. . . . This can be done "on the net" because you can log on whenever convenient. The [class] newsletter has many benefits. Not only is it another way to cement the information, it is also a good source of information for the readers of the articles. The fact that it is edited makes the information reliable. This way of writing is also good because it is good practice for the reports that we will need to generate in the job we hope to get. There is a lot to be said for this. The more one writes the better one gets. This is an outstanding device, this computer. I am a real convert.

The new literacy for the 21st century and beyond is clearly the ability to utilize appropriate technological tools in an information society (Evans, 1999). As the traditional classroom continues to move beyond chalk and talk, a stronger alliance is being formed between content, technology, and active learning. This alliance provides invaluable support to the foundation of a learning centered instructional environment.

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